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15 August 2014

King Farm Parcels F5 & F6
Phase I Noise Analysis

Montgomery County, Maryland

Report #140730

For: Streetscape Partners, LLC

By: Scott Harvey, PE, INCE Bd. Cert.
Kody Snow

Acoustical Engineering Solutions.

EXECUTIVE SUMMARY

King Farm, located in the City of Rockville, is zoned PD-KF and regulated by certain governing documents consisting of an Annexation Agreement and approved Concept Plan. Accordingly, a noise mitigation plan and other associated requirements for noise buffers and mitigation of noise impacts for certain identified "Mixed-Use Zones" do not apply to King Farm. We understand that Staff has requested that StreetScape Partners evaluate transportation noise impact upon the King Farm Parcels F5 and F6, a proposed townhouse development, for informational purposes. Cumulatively, Parcels F5 and F6 will consist of approximately 129 townhomes, including MPDUs. This study was limited to noise impact from Interstate 270, Interstate 270 exit and entrance ramps, Shady Grove Road, and Piccard Drive and included:

- On-site 24-hour noise level measurements.
- Computer modeling.
- Determination of future noise levels.

To perform this study, Phoenix Noise & Vibration has applied the noise criteria established by Montgomery County for purposes of evaluating Mixed-Use Zones. Noise impact at the site will vary with height; therefore impact has been presented at the ground level and upper level. Impact is presented by noise contours of varying levels of color indicating the future roadway noise levels.

All calculated noise levels are "mitigated," accounting for the presence of existing buildings, significant structures, and surrounding topography, as well as future buildings and topography. Structures along roadways act as noise barriers, providing protection from noise exposure and reducing the impact and extent of any potential mitigation required, if any, to maintain recommended outdoor noise levels at 65 dBA Ldn.

Proposed townhomes located closest to Interstate 270, Interstate 270 exit/entrance ramps, and fronting Piccard Drive will be impacted by transportation noise levels greater than 65 dBA Ldn. See Drawings 3 and 4. We recommend that, when final construction plans are prepared, an evaluation of the proposed building structure be done to determine whether modifications in building materials are necessary to maintain interior noise levels at 45 dBA Ldn (as recommended by Montgomery County).

Results also indicate that certain lots located on the exterior of Parcel F5 and Parcel F6, see Table 4, will be impacted by transportation noise levels greater than 65 dBA Ldn at the ground level. However, noise levels in these areas are not required to comply with an outdoor noise limit in the front yards or at the rear yards because the rear yards are utilized for driveways. All other lots located on the interior of Parcels F5 and F6 will experience ground level noise levels below 65 dBA Ldn, mitigation will not be required.

All other residential lots will not be exposed to future transportation noise levels above 65 dBA Ldn. Residential units exposed to future noise levels below 65 dBA Ldn require no further analysis. Modifications to these units are not required; i.e., the building's planned exterior walls and standard windows/doors can be used to maintain indoor noise levels at 45 dBA Ldn.

NOISE TERMINOLOGY

Ldn

The day-night average noise level, or Ldn, is the equivalent sound pressure level (average over a 24-hour period) obtained by adding 10 dB to sound pressure levels measured from 10:00 p.m. to 7:00 a.m. This 10 dB "penalty" accounts for the added sensitivity caused by noise generated during the nighttime hours. The Ldn is not a measurement of the instantaneous noise level.

The Ldn is sometimes referred to as the "DNL," however both terms represent the same quantity. The Ldn is NOT a measurement of the instantaneous noise level. It is very possible to have several short term events (tractor trailer, emergency vehicle siren, car horn, etc.) which generate a relatively high noise level (e.g., 85 dBA) during a given time period, yet have a more moderate overall Ldn value (e.g., 65 dBA Ldn).

Leq

The equivalent continuous noise level, or Leq, is the noise level averaged over a given time period. The Leq does not include any penalties or adjustments. The Leq could represent the noise level over 5 minutes, one hour, the daytime (7:00 AM to 10:00 PM) or nighttime (10:00 PM to 7:00 AM) hours, etc.

dB vs. dBA

While the standard unit of measurement for sound is the decibel (dB), discussions of noise impacting the human ear use "dBA." The "A" refers to a frequency weighting network used to simulate the human ear's unequal sensitivity to different frequencies. The A-weighted noise level is therefore more representative of a human's perception of a noise environment than the unweighted overall noise level in dB and is currently used in most all environmental noise studies.

STC Rating

The Sound Transmission Class (STC) rating is a single number value which indicates a building element's (wall, window, door, roof, etc.) ability to reduce noise transmission from one side of the element to the other. The higher the STC rating, the more noise prevented from passing through that element.

NOISE REGULATIONS

The evaluation of traffic noise impact for proposed residential developments in Montgomery County is governed by Table 2-1 (reprinted in Table 1) on page 8 of the *Staff Guidelines for the Consideration of Transportation Noise Impacts In Land Use Planning and Development* (June 1983). Accompanying this table is Map 2-1, indicating outdoor noise level requirements not to be exceeded throughout the County.

Table 1: Maximum Levels for Exterior Noise & Building Line[1] for Noise Sensitive Land Uses (Table 2-1).

Guideline Value	Area of Application
Ldn = 55 dBA	This guideline is suggested as an appropriate goal in permanent rural areas of the County where residential zoning is for five or more acres per dwelling unit and background levels are low enough to allow maintenance of a 55 dBA Level. This guideline is consistent with Federal, State, and County goals for residential areas.
Ldn = 60 dBA	This is the basic residential noise guideline which will be applied in most areas of the County where suburban densities predominate. Maintenance of this level will protect health and substantially prevent activity interference both indoors and outdoors. Noise attenuation measures will be recommended to allow attainment of this level.
Ldn = 65 dBA	This guideline will generally be applied in the urban ring, freeway, and major highway corridor areas, where ambient levels are such that application of a stricter guideline would be infeasible or inequitable. Significant activity interference will occur outdoors and indoors if windows are partially opened, but available evidence indicates hearing is adequately protected. Noise attenuation measures will be strongly recommended to attain this level.

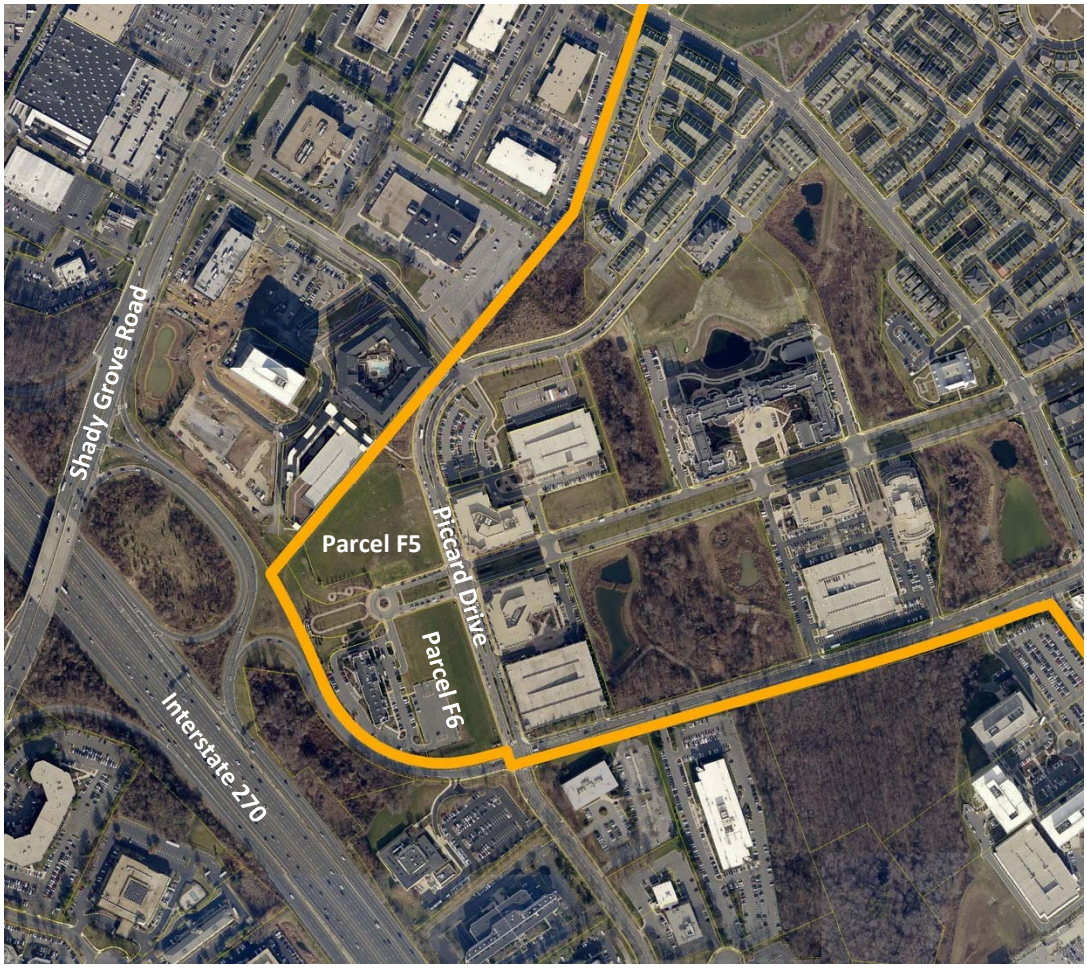
[1] Building line as used here refers to habitable structures only. It does not include garages, sheds, or recreational accessory buildings.

According to Map 2-1, King Farm Parcels F5 & F6 are located within the 65 dBA Ldn noise zone. When outdoor noise levels exceed the guideline value of 65 dBA Ldn, Montgomery County requires an analysis of indoor noise levels in residential buildings. According to Sections 2.2.2 and 2.2.3 of the *Staff Guidelines*, any residential building impacted by noise levels above 60 dBA Ldn should be evaluated to certify that the building structure will be capable of maintaining indoor noise levels at 45 dBA Ldn.

SITE CONDITIONS

The proposed residential development (see Figure 1, property line in red and building in blue) is located approximately 580 feet east of Interstate 270, 790 feet southeast of Shady Grove Road, 200 feet east of the Interstate 270 ramp to Shady Grove Road, 100 feet east of the Interstate 270 exit ramp to Redland Boulevard, and fronts Piccard Drive.

Figure 1: King Farm Parcels F5, F6, and surroundings.



NOISE MEASUREMENTS

On July 17 – July 18, 2014, Phoenix Noise & Vibration conducted an on-site noise measurement survey to determine the existing roadway noise propagation throughout the site. This involved continuous noise level measurements and monitoring for one 24-hour period. Measurements were made using two Norsonic Type 118 and one Norsonic Type 140 Precision Integrating Sound Level Meters. All meters were calibrated prior to the survey and are traceable to National Institute of Standards and Technology (NIST). Each meter meets the ANSI S1.4 standard for Type 1 sound level meters.

During the 24-hour measurement, noise levels were recorded and averaged over five minute time intervals. Noise measurements were then used to calculate the site's 24-hour average day-night noise level (Ldn), which includes the 10 dBA penalty for noise levels measured during nighttime hours.

Noise level measurements were made at two locations shown in Figure 2 (and Drawing 1 and 2 of the Appendix). Measurements were made at 5.5 feet (ground level, GL) and 25 feet (upper level, UL) above adjacent grade to represent the noise impact in outdoor recreation areas and at upper floors, respectively. Each position was located in close proximity to the primary noise sources impacting the property (Interstate 270 and exit/entrance ramps) to establish the individual noise level output from each. Measurement results are presented in Table 1.

Table 1: 24-hour roadway noise measurement results.

Measurement Location	Measured Noise Level (dBA Ldn)
A GL	59.4
A UL	64.2
B UL	66.6

Figure 3 presents the roadway measurement results graphically, showing the noise level as measured in five minute increments throughout the survey. Figure 3 indicates the actual measured values over the 24-hour period. While the 10 dBA nighttime penalty is not shown graphically, it was included in the Ldn calculations.

Note that some of the measurement locations contain isolated instances during the 24-hour measurement period at which the noise level appears inconsistent with the rest of the noise profile (i.e., peaks, spikes, or dips in the graph). These inconsistencies are typically due to extraneous occurrences unrelated to roadway noise, such as emergency sirens or temporary traffic congestion. Such short term events, while producing a relatively high or low noise level and which may have a significant impact on the five minute average, generally have an insignificant effect on the overall, 24-hour Ldn value.

Figure 2: 24-hour noise measurement locations.

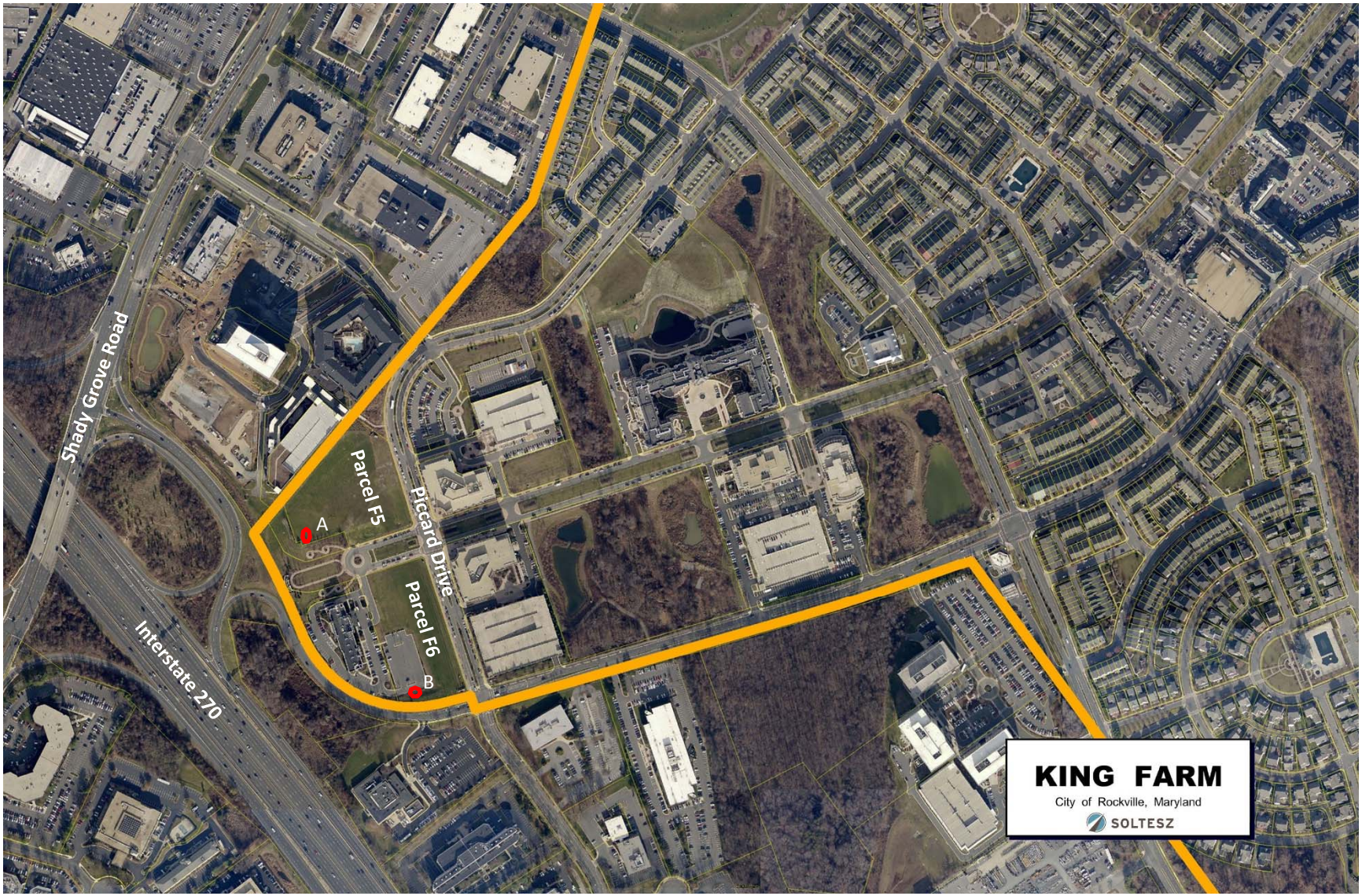
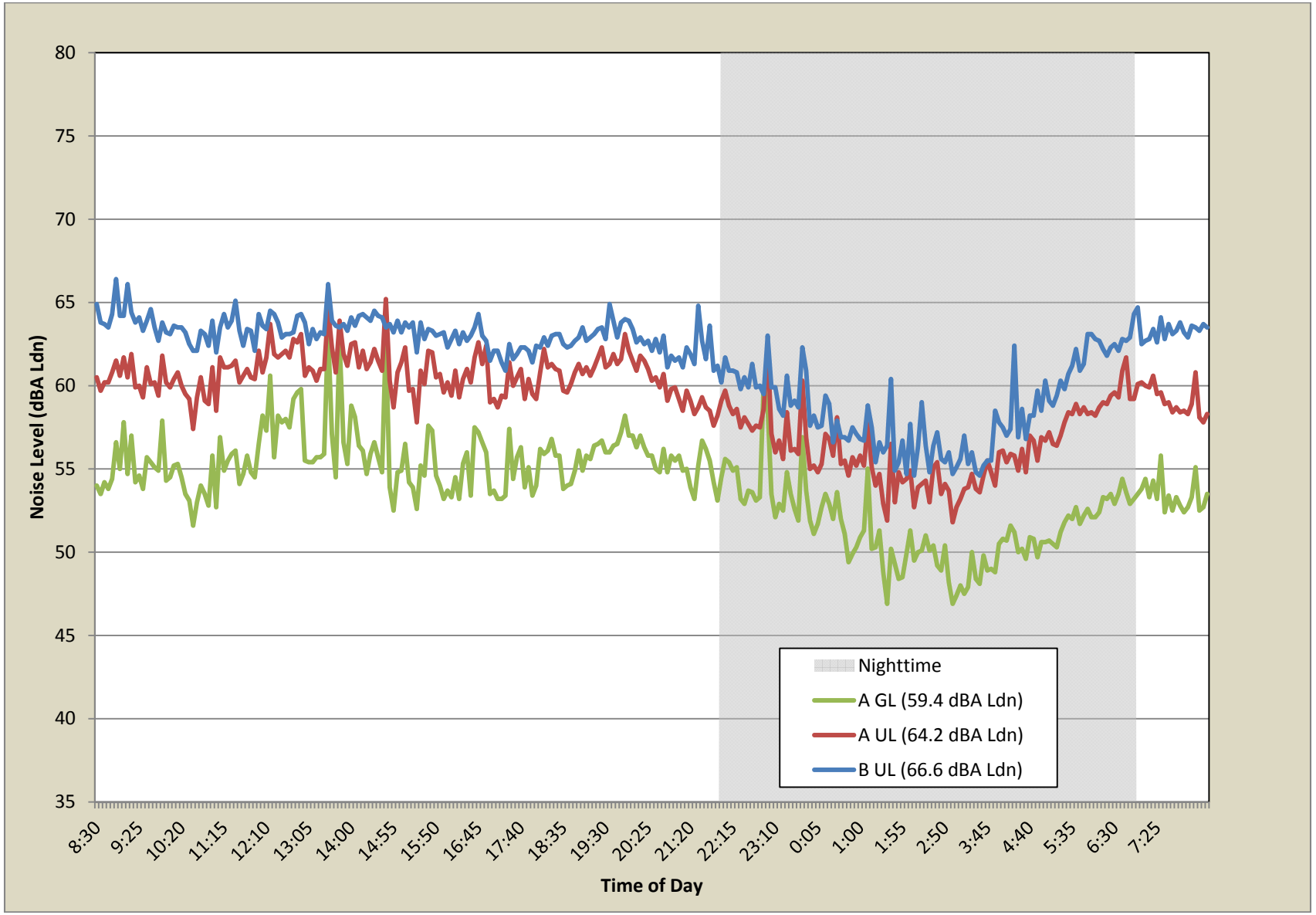


Figure 3: Five-minute average roadway noise levels recorded during 24-hour noise survey.



COMPUTER MODELING

The existing and future sites were computer modeled using the CadnaA software program, a three-dimensional noise propagation model capable of determining the noise level impact from multiple noise sources across vertical and horizontal surfaces while accounting for factors such as topography, trees, ground absorption, reflections, and roadway data (traffic volumes, speeds, and vehicle classifications, etc.). Noise levels can be presented either in spot locations or as noise contours of equal value throughout a defined surface area.

Current Model

A current model was developed to simulate the existing site and its surroundings using information provided on the existing site plan[1] and data collected during the 24-hour measurement survey, inputting existing topography, trees, roadway alignments, and buildings. Roadway noise levels were calibrated using the on-site noise measurements by adjusting the modeled input until the modeled noise level output matched the measured values.

Future Model

A future model was developed by altering the calibrated current model to include the projected roadway data, future site topography, and the proposed townhomes.

The future model calculated the "mitigated" noise levels throughout the site at the ground and upper level. Mitigated noise levels are calculated in the presence of future site topography and buildings, as well as all existing surrounding buildings, topography, and significant structures. Mitigated noise levels account for the effect of buildings, barriers, and other significant structures in reducing and reflecting roadway noise propagation and are more representative of the noise level actually experienced at a specific location.

Roadway Data

Average annual weekday traffic (AAWDT) volumes and vehicle percentages were based upon the most recent data published by the Maryland State Highway Administration (MDSHA), as shown in Table 2. Furthermore, since MDSHA could not provide future traffic data, a conservative, 2% increase in traffic compounded annually until 2034 was assumed.[2] Traffic data for Piccard Drive was based upon observations and data recorded during the noise measurement survey.

[1] Provided by Soltesz.

[2] Most local counties with transportation noise regulations typically require that roadway noise impact studies be conducted using the projected traffic volumes 20 years from the date of the study.

Table 2: Roadway traffic data used in the computer models.

Roadway	Existing AAWDT	2034 AAWDT	Nighttime Volume %	Truck %	Posted Speed Limit (mph)
I-270 NB	109,198	165,508	7%	5%	55
I-270 SB	114,437	173,448	7%	5%	55
I-270 NB to Redland Blvd.	7,472	11,325	7%	3%	30
I-270 NB to Shady Grove Road EB	10,562	16,008	10%	2%	30
I-270 NB to Shady Grove Road WB	5,622	8,521	10%	2%	30
I-270 NB to Shady Grove Road/Redland Blvd.*	28,825	43,689	10%	2%	30
Shady Grove Road	38,351	58,127	7%	8%	40
Shady Grove Road EB to I-270 NB	6,782	10,279	7%	3%	30
Piccard Drive	3,857	5,732	9%	4%	25

*Prior to the ramp splitting for Shady Grove Road and Redland Blvd.

Future Noise Impact

Future mitigated roadway noise contours at the ground and upper level are presented on Drawings 3 and 4 of the Appendix, respectively. Some of the proposed townhomes located nearest the surrounding roadways are impacted by noise levels above 65 dBA Ldn. Table 3 presents the upper level noise impact specific to each residential lot location.

Table 3: Upper level mitigated noise levels impacting residential lots.

Parcel	Lot Number	Outdoor Noise Level (dBA Ldn)
F5	1, 11-18, 32-40, 45, 66, 67	65 - 69
	2-10, 19-31, 41-44, 46-65, 68-76	< 65
F6	1, 27-30, 34-53	65 - 68
	2-26, 31-33	< 65

Noise levels will be above 65 dBA Ldn, in limited circumstances, in the outdoor areas of the townhome and MPDU lots closest to the surrounding roadways (primarily Piccard Drive). Table 4 presents the ground level noise impact specific to each residential lot location.

Table 4: Ground level mitigated noise levels impacting residential lots.

Parcel	Lot Number	Outdoor Noise Level (dBA Ldn)
F5	12-18, 32-40, 66-68	65 - 68
	1-11, 19-31, 41-65, 69-76	< 65
F6	29, 34-53	65 - 66
	1-28, 30-33	< 65

Note that for Parcel F5, lots 12-18 and 66-68, and Parcel F6, lots 34-47, only the front yards of these lots facing Piccard Drive are impacted by noise above 65 dBA Ldn at the ground level.

We recommend that a Building Shell Analysis (see "Mitigation" below) be prepared for those townhouses impacted by the upper level 65 dBA Ldn noise contour to determine the building construction mitigation measures necessary to maintain interior noise levels at 45 dBA Ldn, in accordance with Montgomery County's residential noise standards.

MITIGATION

Indoor Mitigation (Building Shell Analysis)

According to Montgomery County's residential noise standard, buildings impacted by noise levels above 65 dBA Ldn (at any height) require further analysis of final architectural plans to determine the mitigation measures, if any, necessary as part of construction to maintain noise levels in indoor living spaces at 45 dBA Ldn. As discussed above, some of the proposed residences to be constructed on King Farm Parcels F5 and F6 are impacted by noise levels 65 dBA Ldn or greater. The impacted residential lots can be seen in Table 3.

Therefore, we recommend that, when final architectural plans are prepared, a building shell analysis be performed to calculate the noise reduction provided by an exterior building partition (i.e., the composite assembly of the wall and any windows and doors) and the resulting indoor noise level when impacted by a specific outdoor noise level. The noise reduction provided by an exterior partition is dependent upon the surface area each building element composing the partition occupies and the STC rating of the individual elements.

STC ratings apply to one individual element. The composite STC rating is the overall STC rating of a partition with multiple elements (e.g., a wall with a window) and is usually controlled by the building element with the lowest individual STC rating. In residential construction, this is almost always the glass (windows and doors); therefore the percentage of the exterior wall occupied by glass becomes critical. This also means the amount of outdoor noise heard inside a unit is primarily dependent on the glass percentage and STC rating, not the wall STC rating.

High STC rated windows/doors can be significantly more expensive than standard windows/ doors (up to three to four times the cost of standard windows/doors). Phoenix Noise & Vibration

should be contacted early in the design and window/door selection process to provide recommendations to minimize incurred material costs.

Outdoor Mitigation

Townhome lots located on the interior of the site will not be exposed to roadway noise levels above 65 dBA Ldn. See Tables 3 and 4 for the residential lots that are not exposed to roadway noise levels above 65 dBA Ldn. Importantly, in Parcels F5 and F6 there are three and two outdoor public mews amenity spaces, respectively, which are also not exposed to roadway noise levels above 65 dBA Ldn. Thus, the primary outdoor public spaces within the communities are within the recommended limits.

From Drawings 3 and 4 it can be seen which townhome lots are impacted by noise above 65 dBA Ldn at the ground level. Montgomery County does not require mitigation in the front yards of residences. Additionally, Montgomery County does not typically require mitigation in the rear of residential units where such exterior ground floor is utilized as a driveway. Accordingly, no outdoor mitigation is recommended.

CONCLUSION

King Farm Parcels F5 and F6 will be exposed to roadway noise levels up to 69 dBA Ldn. While this level of noise impact is above 65 dBA Ldn, compliance with Montgomery County's interior residential noise standard can be achieved through modifications to the proposed building construction. Depending upon noise level specific to each impacted lot, modifications to the proposed standard construction for residential lots may include increased window/door STC ratings and slight adjustments to exterior wall construction. Once final architecture is determined, the exact mitigation designs necessary, if any, will be established.

Roadway noise will be above 65 dBA Ldn in the outdoor areas of the townhome lots closest to the surrounding roadways. See Drawing 4. As noise levels in the outdoor areas are either the front yard of units or the rear of units with driveways, no additional mitigation will be necessary.

APPENDIX

LEGEND

⊕ MEASUREMENT LOCATION

PHOENIX noise & vibration
5216 Chairmans Court Suite 107
Frederick, MD 21703
301-846-4227

KING FARM PARCEL F5
MEASUREMENT LOCATIONS

DWG. NO.	DATE
1	29-JUL-2014
SCALE	DRAWN BY
NOT TO SCALE	KNS

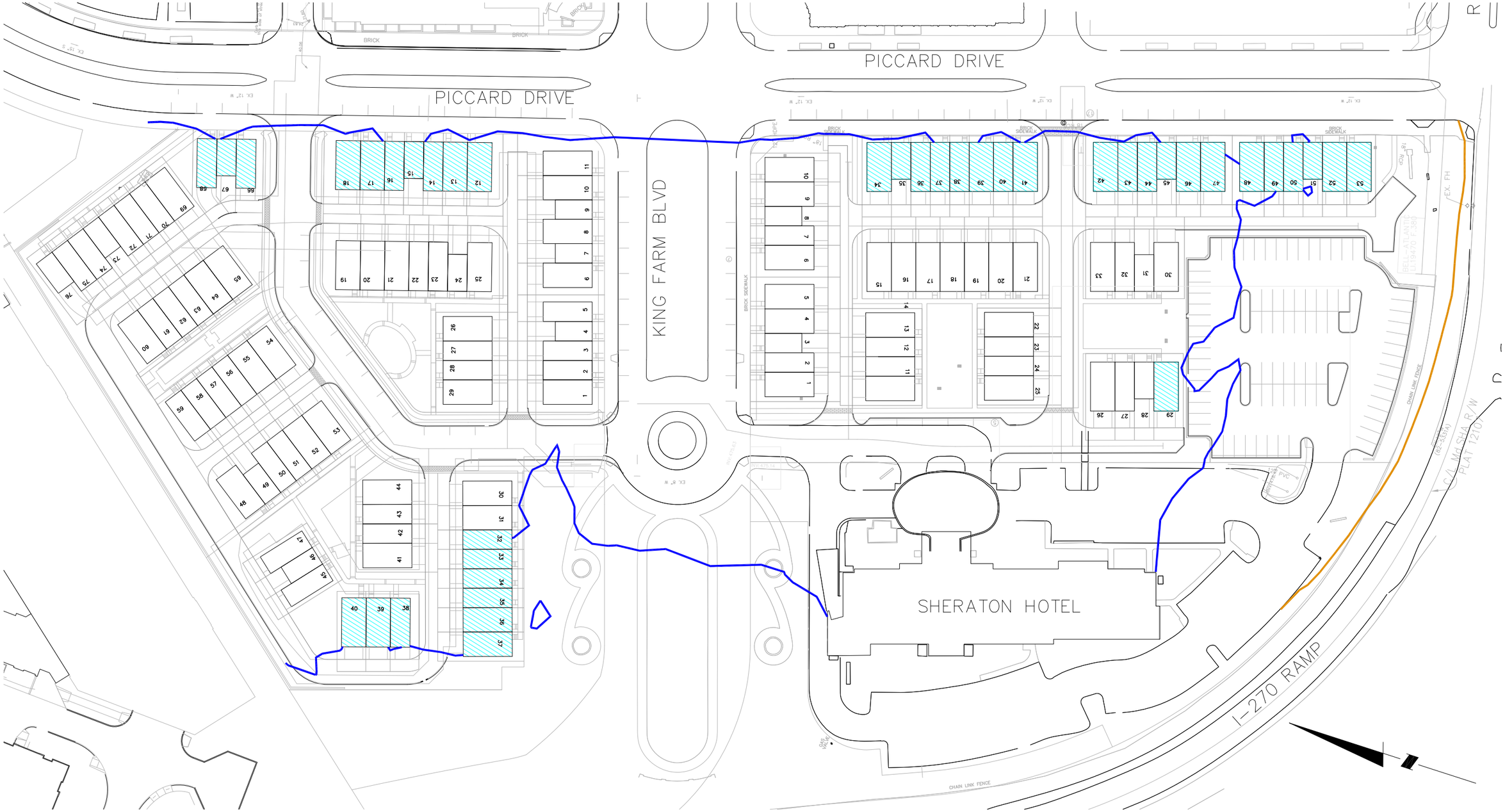
LEGEND

⊕ MEASUREMENT LOCATION

PHOENIX noise & vibration
5216 Chairmans Court Suite 107
Frederick, MD 21703
301-846-4227

KING FARM PARCEL F6
MEASUREMENT LOCATION

DWG. NO.	DATE
2	29-JUL-2014
SCALE	DRAWN BY
NOT TO SCALE	KNS



FUTURE GROUND LEVEL NOISE LEVEL

- 70 dBA Ldn
- 65 dBA Ldn
- RESIDENTIAL LOTS IMPACTED BY 65 dBA Ldn AT THE GROUND LEVEL

PHOENIX noise & vibration
5216 Chairmans Court Suite 107
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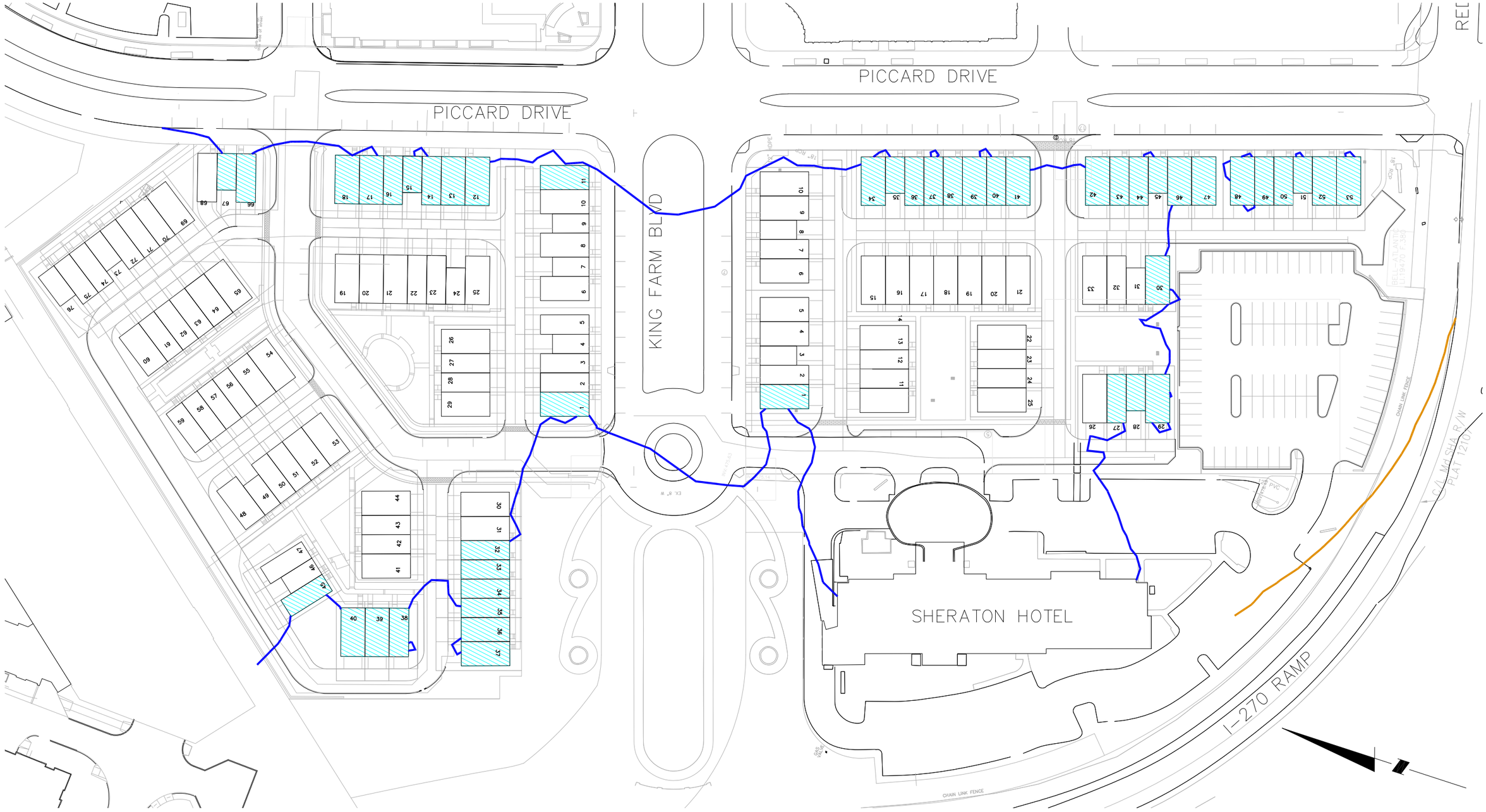
301-846-4227

KING FARM PARCELS F5 & F6

FUTURE MITIGATED GROUND LEVEL NOISE CONTOUR

DWG. NO.	DATE
3	15-AUG-2014
SCALE	DRAWN BY
NOT TO SCALE	KNS



FUTURE UPPER LEVEL NOISE LEVELS

70 dBA Ldn

65 dBA Ldn

RESIDENCES IMPACTED BY 65 dBA Ldn AT THE UPPER LEVEL

PHOENIX noise & vibration
5216 Chairmans Court Suite 107
Frederick, MD 21703
301-846-4227

KING FARM PARCELS F5 & F6

FUTURE MITIGATED UPPER LEVEL NOISE CONTOURS

DWG. NO.	DATE
4	15-AUG-2014
SCALE	DRAWN BY
NOT TO SCALE	KNS